



# Integrated river and pipe modelling

Combining open-channel, closed pipe and overland flow



## Cost-effective integrated modelling solutions.

The ISIS suite consists of various one-dimensional (1D) and two-dimensional (2D) hydraulic modelling packages such as ISIS Professional and ISIS 2D. BMT WBM's 2D modelling software, TUFLOW, also complements our range of software and has allowed us to develop various products which enable users to dynamically link these well established modelling packages together. These include the ISIS-TUFLOW link and the ISIS-TUFLOW-PIPE link.

### ISIS-TUFLOW-PIPE Link

The new ISIS-TUFLOW-PIPE Link now offers even more flexibility with a direct 1D-1D dynamic link between ISIS and TUFLOW's 1D component (ESTRY).

This builds on the established ISIS (1D) and TUFLOW (2D) link and fully combines the complementary strengths of the well-established ISIS 1D software (e.g. 1D open channel flow, a wide range of structures and complex operating rules), and TUFLOW's 1D component, whose additional strengths are in pipe modelling, especially those of small cross-sectional area and conveying low or no flows.

This allows, for example, an ESTRY (1D) pipe network to be dynamically linked to ISIS (1D) river units, which can all be linked to TUFLOW's 2D domain(s).

TUFLOW's 1D component includes industry leading algorithms for modelling manholes and time-varying energy losses at manholes and pipe junctions. Manholes can be specified via GIS layers or automatically created at closed pipe junctions.

Several mechanisms for calculating energy losses at manholes are available. The most sophisticated is an enhanced Engelund approach that re-calculates the energy losses every timestep based on the manhole shape, expansion and contraction of flow, flow distribution between pipes, angles of approach, invert drops and other characteristics.

The ISIS-TUFLOW-PIPE Link enables an integrated approach to modelling, combining open-channel, closed pipe and overland flow, suitable for modelling flood risk in urban areas, amongst other scenarios.

In combination with ISIS, the ability to dynamically link storm water drainage networks and overland flow makes TUFLOW extremely powerful for modelling urban catchments. This could involve interactions between roads and the underground piped system.

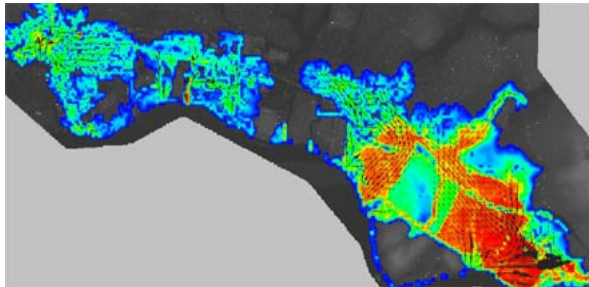


Large drainage networks with tens of thousands of 1D elements (pipes, open drains, pit inlets and manholes) connected to millions of 2D cells have been modelled.

## ISIS-TUFLOW Link

The well established ISIS-TUFLOW Link is a dynamic link between ISIS Professional (1D) and TUFLOW (2D) hydraulic modelling software. It has been commercially available since 2004 and allows information, such as flow and water levels to be exchanged between the two models.

The ISIS-TUFLOW Link fully combines the complementary strengths of ISIS Professional such as 1D open channel flow, a wide range of structures and complex operating rules alongside TUFLOW's 2D domains. This provides the user with great flexibility in producing an integrated model using the most appropriate modelling method for different parts of the floodplain.



Models constructed in ISIS-TUFLOW build on the well proven track record of the separate ISIS and TUFLOW modelling software packages.

Existing ISIS and TUFLOW models can be linked together with minimal extra effort, making use of concepts already familiar to the ISIS and TUFLOW modeller. ISIS can be linked to TUFLOW via HX and SX boundaries so that level or flow information can be exchanged between the two models.

The exchange can be driven by either component, therefore ISIS calculates water level; TUFLOW calculates discharge or ISIS calculates discharge; TUFLOW calculates water level. Exchange of information between the two models will occur at each multiple of the common time step.

The ISIS model can be linked to multiple TUFLOW 2D domains and each 2D domain can have a different time step and resolution.

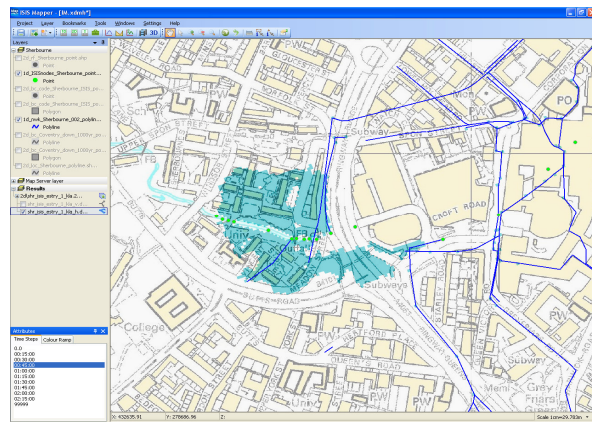
## Key benefits of the ISIS-TUFLOW Link:

- An existing ISIS model is fully compatible with an ISIS-TUFLOW linked model
- Permits detailed modelling of different parts of the floodplain which would not be possible in just ISIS or TUFLOW
- Combines the capability of ISIS for dealing with structures and that of TUFLOW for dealing with rapid flooding and drying processes, both of which are critical to the accuracy of flood prediction.
- Existing ISIS and TUFLOW models are quickly and easily converted for use in ISIS-TUFLOW

## Delivering value – case study

### ■ Integrated urban modelling, Coventry, UK

The ISIS-TUFLOW-PIPE Link has been used to model combined fluvial and pluvial sources of potential flooding in Coventry. This built on an existing ISIS model of the main watercourse, linking to underground (1D) and overland (2D) flow in TUFLOW. A rainfall event was then applied to the whole area in TUFLOW, and fluvial inputs to the ISIS model.



All three components were linked dynamically, demonstrating the interaction between the differing constituents of a complex urban network. This study represents how easily the drainage network could be input as 1D components in TUFLOW, linked to the existing ISIS model of the open channel and culverted watercourses and allied to the 2D overland modelling capabilities of TUFLOW with multiple sources of flooding input.

## Contact us

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